Association of self-efficacy and self-regulation with nutrition and exercise behaviors in a community sample of adults

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Abstract

This study examined the association of self-efficacy and self-regulation with nutrition and exercise behaviors. The study used a cross-sectional design and included 108 participants (54 men, 54 women). Nutrition behaviors (fruit/vegetable consumption, dinner cooking, and restaurant eating) and exercise were measured using total days in last week a behavior was reported. Instruments measuring self-efficacy and self-regulation demonstrated excellent Cronbach's alphas (.93 - .95). Path analysis indicated only fruit/vegetable consumption and exercise were associated with self-efficacy and self-regulation. Self-regulation showed direct association with fruit/vegetable consumption and exercise, but self-efficacy had direct association only with exercise. Self-efficacy and self-regulation should be strategically used to promote health behaviors.

Keywords: nutrition, self-efficacy, self-regulation, path model, obesity, nutrition, physical activity

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In the U.S., 40% of adult premature deaths are attributable to unhealthy lifestyle patterns; these deaths are preventable with healthy eating and increased physical activity (Bryant, Worjoloh, Caughey, & Washington, 2010). For instance, an increase of one serving of fruits and vegetables a day can reduce cardiovascular risk by 6-11% (Ahluwalia et al., 2007). Even so, 38% and 28% of U.S. adults, respectively, do not eat fruits and vegetables daily (National Center for Chronic Disease Prevention and Health Promotion, 2013), and 23% do not participate in any physical activities (Centers for Disease Control and Prevention, 2012). Interventions to promote healthy eating and physical activity of the general public are critical. Interventions, however, need to target major determinants of behavior change in order to be effective. This study examined the association of two major health behavior determinants, self-efficacy and self-regulation, with nutrition and exercise behaviors in a sample of community adults.

Self-efficacy and self-regulation are both important determinants of behavior change; however they are proposed to be influential at different phases of behavior change. For example, Schwarzer (2008) in the Health Action Process Approach Model proposes that health behavior change involves two phases; the initial intention to adopt a new behavior, influenced by personal beliefs such as self-efficacy, and subsequent behavior maintenance, influenced by self-regulatory efforts such as action planning and coping. The model proposed by Rothman and colleagues (2011) describe four phases of behavior change - that is initial response, continuing response, maintenance, and habit. Self-efficacy and self-regulation play important roles in executing actions during initial and continuing response phases. As a person moves to the maintenance phase, self-efficacy becomes less important, but the strength of self-regulation increases. When a health behavior has become a habit, a person performs the behavior persistently and the behavior sustains itself without much emphasis on self-efficacy or self-regulation. Given the large portion of adults who do not eat any fruits/vegetables in a given day or engage in exercise regularly, it could be assumed that these health behaviors are not a habit and that both self-efficacy and self-regulation are important in influencing these health behaviors.

Self-efficacy refers to one's confidence in exercising control over one's health behaviors in order to produce desired effects (Bandura, 2004); is often measured relative to a specific task (Ritter & Lorig, 2014); and is believed to influence behavior intention as well as health behavior (Luszczynska, Scholz, & Schwarzer, 2005). In the Health Action Process Approach Model (Schwarzer, 2008), an important aspect of self-efficacy is one's confidence in performing a health behavior even when barriers or interruptions occur. To date, there is support for the importance of self-efficacy for nutrition and physical activity intentions and behaviors among various populations. Literature shows that self-efficacy influences intention to eat fruits and vegetables in adults aged 20 to 65 without major medical problems (Guillaumie, Godin, Manderscheid, Spitz, & Muller, 2012). In addition, self-efficacy was found in previous studies to be a significant predictor of nutrition and physical activity among overweight or obese women (Fisher & Kridli, 2014), of dietary changes in a low-socioeconomic middle-aged rural population (Shannon et al., 1997), and of fruit/vegetable intakes among young adults (Horacek et al., 2002; Strachan & Brawley, 2009).

Self-regulation includes a spectrum of effortful activities such as goal setting, affect regulation, coping strategy development, problem solving (Johnson, Pratt, & Wardle, 2012), self-monitoring, self-reinforcement, self-evaluation (Maes & Karoly, 2005), cognitive restructuring, and stimulus control (Annesi & Gorjala, 2010). Self-regulation also facilitates behavior transition from intention to action – the initiation phase. For instance, among people who value healthy eating and intent to eat right, those with higher self-regulation ability are more likely to eat fruits and vegetables than those with low such abilities (Allom & Mullan, 2012). Empirical data have also shown that self-regulation improves nutrition and physical activity among web-recruited study participants, university students, and patients with coronary health disease (Anderson et al., 2007; Scholz, Nagy, Gohner, Luszczynska, & Kliegel, 2009; Sniehotta, Scholz, & Schwarzer, 2005).

Research about self-efficacy and self-regulation is abundant; however, most of these studies include either self-efficacy or self-regulation in a single study (Rothman, Sheeran, & Wood, 2009) while those including both self-efficacy and self-regulation are scarce. In addition, findings about how self-efficacy and self-regulation work together to influence nutrition and exercise behaviors are inconsistent. One previous study found that self-efficacy and self-regulation together explained 17% of the variance in fruit/vegetable consumption and 47% of the variance in physical activity in obese adults enrolled in a treatment program (Amnesi, 2011). Another study found that self-efficacy could only influence nutrition behavior through self-regulation and only on certain nutrition behaviors such as fat, fruit/vegetable, and fiber intakes (Anderson et al., 2007). Clearly, more research is needed to understand how behavior determinants influence nutrition and physical activity behaviors.

In summary, literature indicates that self-efficacy and self-regulation are two important health behavior determinants. Self-efficacy is likely to help early initiation of behavior change and self-regulation for continuing response and maintenance phases. However, it is not clear how both determinants influence health behaviors related to nutrition and physical activity. The purpose of our study is to examine the association of self-efficacy and self-regulation with nutrition and exercise behaviors in a sample of community adults, with a specific aim to assess direct and indirect influences of each determinant on such behaviors.

Methods

A cross-sectional design was used. This study was approved by the Institutional Review Board of a state university.

Subjects and Setting

Subject inclusion criteria were 18 years old or older and able to read English. Study participants were recruited in fall 2013 from a community event in a town located in the Midwest. Various booths were set up for the event to promote camaraderie and business. A data collector from our study stood by a booth with a theme of health and wellness. About 400 patrons passed by the booth and were invited to participate in this study. No formal written consent was obtained. Willingness to complete the survey indicated consent to participate in the study. A flyer about the purpose and procedure of the study was given to patrons who were interested in the study. Weight and height data were self-reported. No compensation (money or gifts) was given to participants. A total of 115 patrons filled out the survey; however, seven surveys (five by males and two by females) were not used in the analysis because they were missing 50% or more of the answers. The final analysis included 108 participants (54 men and 54 women).

In 2013, the town from which study participants were recruited had a population of 14,042 with 84.2% being white, 10.4% Hispanic or Latino, and 1.6% black or African American; 15% were below poverty level and 61.4% were between the ages of 18 and 64 (United States Census Bureau. 2013). The county in which the study town is located, as compared to the U.S. top performing counties in the 90th percentile, has more premature deaths (6,992 vs. 5,317), higher rates of adult obesity (31% vs. 25%) and physical inactivity (26% vs. 21%), and lower rates of access to exercise opportunities (48% vs. 85%) and diabetic screening (85% vs. 90%) (County Health Rankings and Roadmaps, 2014).

Measures

Self-efficacy. The Nutrition Self-Efficacy Scale and the Physical Exercise Self-Efficacy Scale (Renner & Schwarzer, 2005; Schwarzer & Renner, 2000, 2013) measured nutrition and exercise self-efficacy, respectively. Each scale includes five questions about how certain a person is that he or she could overcome barriers to eating healthy foods or physical exercise. Responses were rated on a four-point Likert scale (1 = *very uncertain*, 2 = *rather uncertain*, 3 = *rather certain*, and 4 = *very certain*). Summative scores were used for analysis. A higher total score indicates stronger self-efficacy. Sample questions from these two scales are “I can manage to stick to healthful foods even if I need a long time to develop the necessary routines” and “I can manage to carry out my exercise intentions even when I am tired.” High internal reliability, as demonstrated by Cronbach’s alphas of .85-.87 for the nutrition scale (Schwarzer & Renner, 2000, 2013) and .88-.89 for the physical exercise scale (Poomsrikaew et al., 2012; Schwarzer & Renner, 2013), were reported by previous researchers. In our study, the Cronbach’s alphas were .93 for both scales.

Self-regulation. The Healthy Eating Change Strategies Scale and the Physical Activity Change Strategies Scale (Saelens et al., 2000) were used to measure nutrition and exercise related self-regulation efforts, respectively. Each scale includes 15 questions asking a study participant how often he/she performs each of 15 self-regulatory behaviors, including self-monitoring, problem solving, affect control, goal setting, self-reinforcement, and relapse prevention. Questions are rated on a five-point Likert scale (1 = *never*, 2 = *almost never*, 3 =

sometimes, 4 = *often*, and 5 = *many times*). Mean scores for the 15 questions were used for analysis. A higher mean score indicated stronger self-regulation. Cronbach's alphas reported by other researchers were 0.91 for the nutrition scale (Norman et al., 2010) and .89 for the physical activity scale (Carlson et al., 2012). In our study sample, the Cronbach's alphas were .94 for the Healthy Eating Change Strategies Scale and .95 for the Physical Activity Change Strategies Scale.

Nutrition behaviors. Previous studies have indicated that fruit/vegetable consumption, meal preparation for dinner at home, and eating outside the home are important indicators when assessing dietary behaviors because they imply individual, family, and social contexts for interventions (Crawford, Ball, Mishra, Salmon, & Timperio, 2006; Kant & Graubard, 2015; Laska, Larson, Neumark-Sztainer, & Story, 2011). These three behaviors, therefore, were assessed using questionnaires developed for the study. Study participants were asked how many days in the past week that they had eaten fruits and vegetables, cooked their own dinner, and ate at a restaurant. Responses could range from 0 to 7 days. Number of days in previous week for each behavior was used in the analysis. A higher frequency for fruit/vegetable consumption and dinner cooking, and a lower frequency for eating at a restaurant indicate more healthy nutrition behaviors.

Exercise behavior. One single question was used to assess frequency of exercise in the past week. Using a single question to assess physical activity efforts in a week was also reported by other researchers (Södergren, Sundquist, Johansson, & Sundquist, 2008). Participants in our study were asked how many days in the past week they had exercised. Responses ranged from 0 to 7 days. Again, number of days was used in the analysis.

Data analysis

Descriptive statistics were used to characterize the sample including demographic characteristics and lifestyle behaviors. Path model analysis was performed to assess the association of self-efficacy and self-regulation with nutrition and exercise behaviors. Two separate path models were tested for nutrition behaviors and exercise, respectively. We first explored the best fit model. A Bayes method, as implemented in MPlus version 7.2 (Asparouhov & Muthén, 2010; Muthén & Muthén, 2012), was used to estimate model parameters and test fit. A Bayes approach was chosen because it performs better than maximum likelihood methods with smaller samples and non-normal distributions (Muthén & Asparouhov, 2012). Non-informative priors were used to start the estimation algorithm because they allow us to do exploratory analyses. Convergence and model fit were evaluated using trace and autocorrelation plots for the parameter estimates as well as the potential scale reduction and the posterior predictive *p*-value. After a best model was determined, we assessed the association of each determinant with each behavior, as well as direct and indirect relationships of determinants to behaviors. Posterior credibility intervals (*CI*) for individual parameter estimates were used to determine whether or not an association was significant. A *CI* that included a value of zero was interpreted as there being no substantive independent association (Muthén & Asparouhov, 2012). Statistical analysis was carried out by using SAS version 9.3 (SAS Institute Inc., 2011).

Results

Detailed demographic and lifestyle information about the study participants is presented in Table 1. Most of the 108 participants were Caucasian (80%), aged 20 to 49 years old (68%), and living with others (79%). There were equal numbers of men (50%) and women (50%) in the study. Over one half (59%) of the study participants were overweight/obese, but only one quarter

(26%) had tried to lose weight in the last month. Of those who had tried to lose weight, many (57%) used both diet and exercise. During the week before data collection, 31% of participants had not engaged in any physical activity, 4% had not eaten any fruits and vegetables, 10% had not cooked any dinner, and 6% had eaten at restaurants six or more days.

Insert Table 1 about Here

Path Model

Bivariate correlations, means, and standard deviations for nutrition and exercise models appear in augmented correlation matrices provided in Table 2. Positive correlations were found between nutrition self-efficacy and nutrition self-regulation ($r = 0.649$, $p < .001$) and between physical activity self-efficacy and physical activity self-regulation ($r = 0.661$, $p < .001$).

Insert Table 2 about Here

Nutrition path model. The nutrition path model with path coefficients and standard errors in Figure 1 shows the association of self-efficacy and self-regulation with nutrition behaviors (fruit/vegetable consumption, dinner cooking and restaurant eating). The model fitted the observed data (95% *CI* for difference between observed and the replicated Chi-Square values: -16.6, 18.4; posterior predictive *P*-value: 0.459; number of free parameters: 18). R^2 values for endogenous variables (nutrition self-regulation, fruit & vegetable consumption, dinner cooking, and restaurant eating) ranged from 0.41 (95% *CI*: 0.28 – 0.53) for nutrition self-regulation to 0.04 (95% *CI*: 0.002 – 0.129) for restaurant eating. Of the four endogenous variables in the model, only two exhibited direct effects whose 95% *CI*s did not encompass zero. Specifically, there was a positive direct effect for nutrition self-regulation on fruit and vegetable consumption ($\beta_{21} = 0.619$; 95% $CI = 0.306 - 0.930$) and for nutrition self-efficacy on nutrition self-regulation ($\gamma_{11} = 0.144$; 95% $CI = 0.111 - 0.177$). In addition, the indirect effect (*IE*) for nutrition self-efficacy on fruit and vegetable consumption, acting through nutrition self-regulation, was non-zero (*IE* = 0.088; *SE* = 0.025; 95% *CI* = 0.042 - 0.141).

Insert Figure 1 about Here

Exercise path model. Path coefficients and standard errors for the exercise model are provided in Figure 2. The model fitted the observed data (95% *CI* for difference between observed and the replicated Chi-Square values: -10.761, 11.523; posterior predictive *P*-value: 0.484; number of free parameters: 7). R^2 values for endogenous variables were 0.48 (95% *CI*: 0.35 – 0.59) for exercise and 0.43 (95% *CI*: 0.29 – 0.54) for physical activity self-regulation. Each of the three direct effects in the model exhibited 95% *CI*s that did not encompass zero. Specifically, there were positive direct effects for exercise self-efficacy on exercise self-regulation (γ_{11} = 0.147; 95% *CI* = 0.115 - 0.180) and exercise (γ_{21} = 0.114; 95% *CI* = 0.056 - 0.171), and for exercise self-regulation on exercise (β_{21} = 0.564; 95% *CI* = 0.303 - 0.825). Further, the indirect effect for exercise self-efficacy on exercise, acting through exercise self-regulation, was non-zero (*IE* = 0.082; *SE* = 0.022; 95% *CI* = 0.043 - 0.128).

Insert Figure 2 about Here

Discussion

This study increased the understanding of the association of self-efficacy and self-regulation with nutrition and exercise behaviors in a sample of adults recruited from a community event. Of the three nutrition behaviors (fruit/vegetable consumption, dinner cooking, and restaurant eating) assessed in our study, only fruit/vegetable consumption was associated with self-efficacy and self-regulation. This finding is in concert with previous studies that addressed positive association of self-efficacy and self-regulation with fruit/vegetable eating (Amnesi, 2011; Anderson et al., 2007; Strachan & Brawley, 2009). A previous study, however, found that higher self-efficacy was related to more frequent preparation of home-based meals and less eating outside the home, especially in fast-food restaurants (Morin, Demers, Turcotte, & Mongeau, 2013). The difference may be explained by the fact that the previous study was focused on working adults with small children. Other variables not included in our study, such as lack of time or cooking knowledge (Jones, Walter, Soliah, & Phifer, 2014), may also have contributed to the difference.

We found that, self-regulation was positively associated with fruit/vegetable consumption and exercise, and that self-regulation demonstrated consistent direct influence on fruit/vegetable consumption and exercise. These findings imply that when designing health campaigns or health behavior interventions to promote fruit/vegetable consumption and exercise, health professionals may consider building self-regulation capability of individuals, families, or populations. Self-regulatory strategies such as self-observation of own behavior, using criteria and goals, and self-reaction by a feedback system have been proposed by health behavior experts (Clark & Zimmerman, 2014). Empirical data have shown that self-regulatory effort as simple as setting up detailed behavior change goal or self-monitoring of own health behavior is effective in improving fruit/vegetable consumption and exercise in various adult populations (Bird et al., 2013; Michie, Abraham, Whittington, & McAteer, 2009; Northwehr & Yang, 2007). Teaching a client or a family to set goals for fruit/vegetable eating and exercise could be a self-regulatory strategy. At the population or community level, an example of self-regulatory strategy could be creating a billboard that says “Have you tracked your 5 fruits/vegetables and 30 minutes walking today?”

Based on our study sample, self-efficacy plays different roles in influencing fruit/vegetable consumption and exercise. We found that (1) self-efficacy was positively associated with exercise and (2) self-efficacy directly influenced exercise but not fruit/vegetable consumption. Two reasons may explain these findings. First, eating occurs multiple times a day. When such behavior needs to be repeated day in and day out, only personal confidence may not be enough to change eating behavior; self-efficacy may need to work with self-regulation to be more effective. Second, our study included a high percentage (31%) of participants who did not engage in any exercise, but only about 4% who did not eat any fruit/vegetable. We did not measure stages of behavior change; however, these percentages might suggest that in this study sample more people were in a beginning behavior change stage for exercise than for fruit/vegetable consumption. As stated by Rothman et al. (2011), self-efficacy is important in the initial behavior change phase and it becomes less important during maintenance phase of behavior change. Nevertheless, further studies to examine how self-efficacy and self-regulation evolve during different stages of behavior change are warranted. Some self-efficacy strategies to enhance behavioral competency used by researchers include facilitation of achievable accomplishments, exposure to various experiences, use of social and verbal persuasion, and awareness of physiological and affective state before and after the desired activity (Marks, Allegrante, & Lorig, 2005).

In our study, two behavior change determinants were correlated with each other, and self-efficacy could indirectly influence fruit/vegetable consumption and exercise, acting through self-regulation. As stated by Rothman, Sheeran, and Wood (2009), health behavior is operated by two systems: reflective and automatic. Reflective system refers to being consciously aware of thinking reflectively or using simple decision rules. Automatic system operates outside the awareness and is activated in a particular situation. Self-efficacy is reflective thought. Some self-regulatory strategies could be reflective (e.g., self-monitoring) or automatic (e.g., setting goal).

While combining self-efficacy and self-regulation strategies in personal counseling, health education, or population and community health campaigns may be helpful in promoting fruit/vegetable consumption and exercise, our study findings indicate that enhancing one single determinant may be as useful as improving two determinants because each determinant shows direct influence on fruit/vegetable consumption, exercise or both.

Limitations of this study include a relatively small sample; however, the success of this study warrants large scale studies to validate these path models. A cross-sectional study design was used in this study and therefore causal effects could not be generated. Nutrition and exercise behaviors were self-reported data from study participants. Social desirability may have played a role in inflating fruit/vegetable consumption and exercise behaviors. We used a single question to assess nutrition and exercise behaviors. This method may not fully measure nutrition and exercise behaviors. A single question, however, can reduce respondent burden. Many previous studies also adopted one single question method to measure fruit/vegetable consumption or exercise (Allom & Mullan, 2012; Lange et al., 2013; Södergren, Sundquist, Johansson, & Sundquist, 2008).

In conclusion, self-efficacy and self-regulation are associated with fruit/vegetable consumption and exercise; their functions in influencing fruit/vegetable consumption and exercise behaviors, however, are different when both determinants are together in a model. For fruit/vegetable consumption, self-efficacy plays an indirect role, but self-regulation exerts direct influence on fruit/vegetable consumption. To improve fruit/vegetable consumption of a client or a population, health professionals could develop interventions to enhance self-regulation capabilities, such as self-monitoring or setting concrete behavior change goals. For exercise, both self-efficacy and self-regulation play a direct role in influencing exercise behavior. Interventions that increase self-confidence, self-regulation or both are likely to improve exercise in a person or a population. Because of their unique contributions to behavior change, self-efficacy and self-regulation could be strategically incorporated in interventions to improve specific health behaviors.

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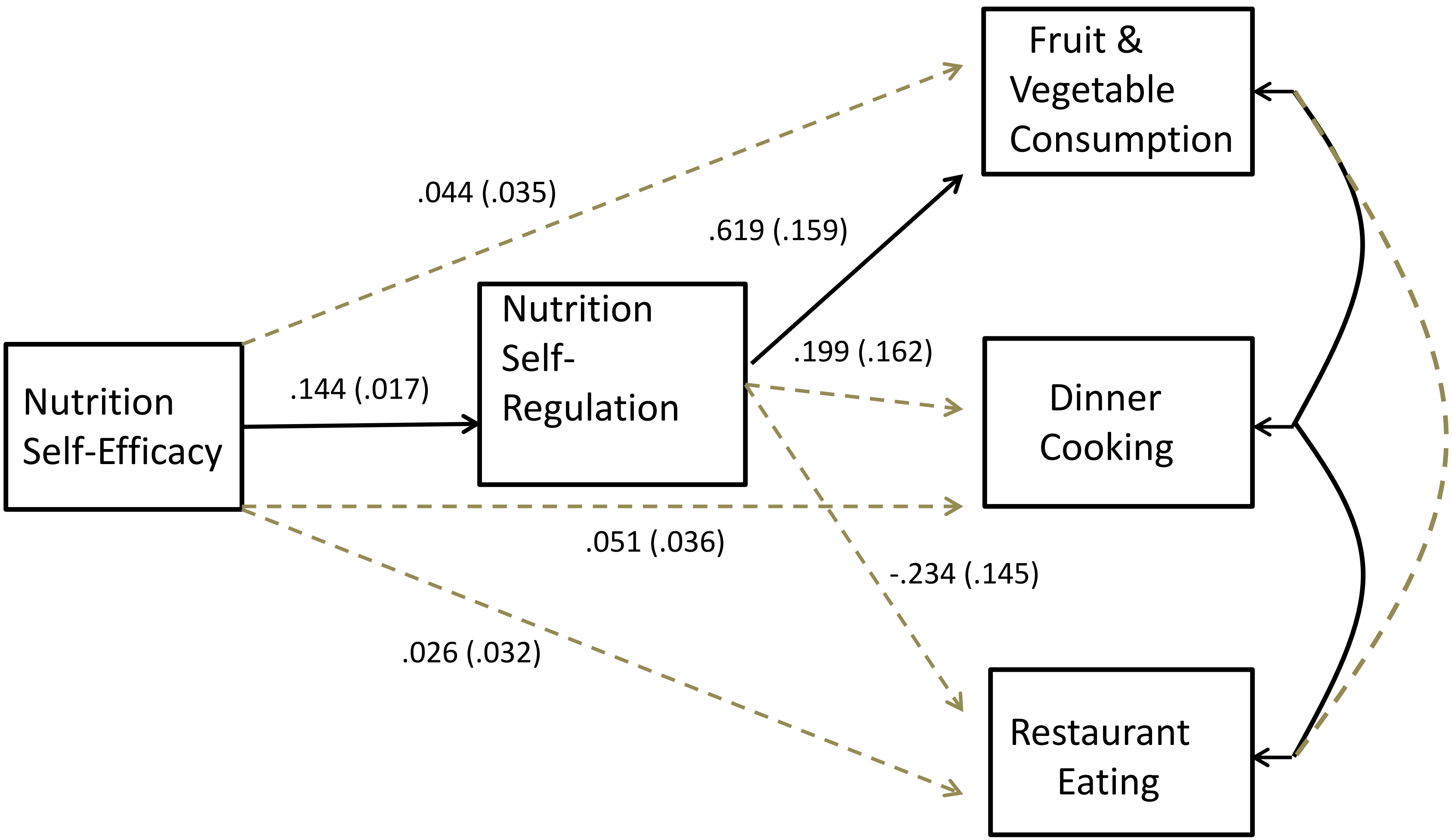
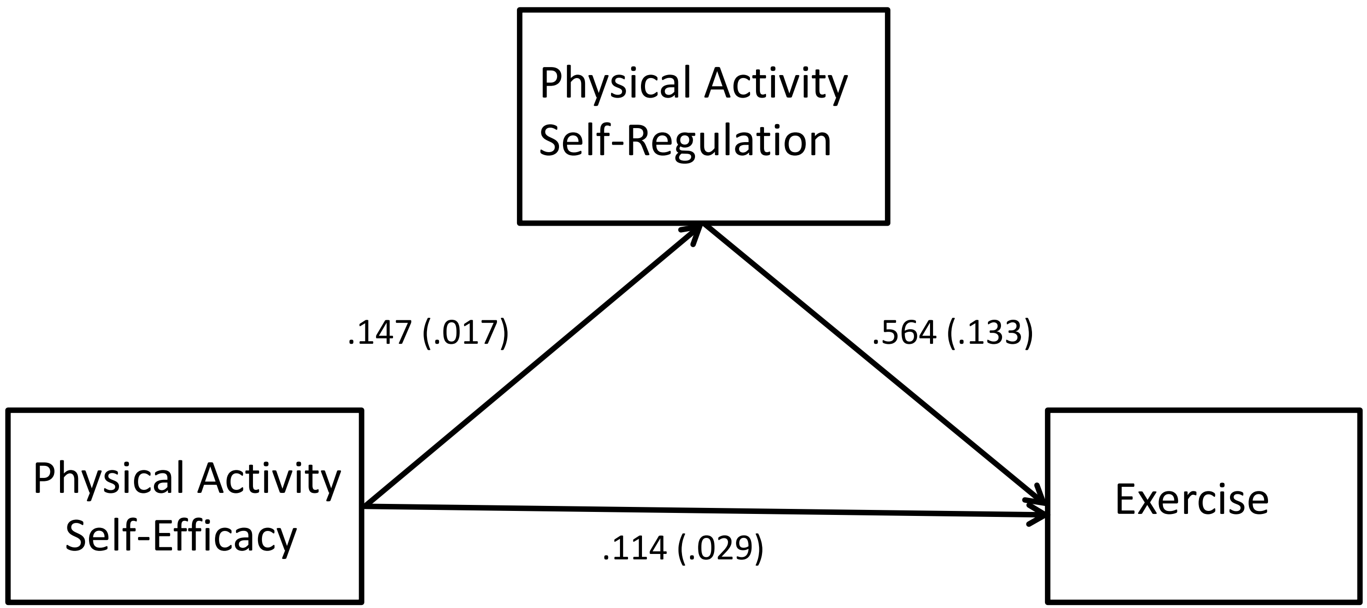
Figure 1. Nutrition Path Model with Path Coefficients and Standard Errors in Parentheses



Note: Dashed lines indicate 95% credibility interval encompassing 0 (no independent association).

Figure 2. Exercise Path Model with Path Coefficients and Standard Errors in Parentheses



Note: No 95% Credibility Interval encompassed 0.

Table 1: Demographic, Eating and Physical Activity Habits of the Study Participants (*N* = 108)

Characteristics	*n* (%)	Characteristics	*n* (%)
Age: (ys):		BMI:	
≤ 19	16 (14.8%)	Underweight (≤ 18.49)	3 (2.8%)
20-29	34 (31.5%)	Normal (18.5-24.99)	41 (38.0%)
30-39	21 (19.4%)	Overweight (25.0-29.99)	44 (40.7%)
40-49	18 (16.7%)	Obese (≥ 30.0)	20 (18.5%)
50-59	8 (7.4%)		
≥ 60	11 (10.2%)		
Gender:		Health problems affecting weight:	
Male	54 (50%)	Yes	12 (11.1%)
Female	54 (50%)	No	95 (88.0%)
		Missing	1 (0.9%)
Ethnicity:		Ate fruits/vegetables last week:	
Caucasian	86 (79.6%)	None	4 (3.7%)
African American	9 (8.3%)	1-3 days	26 (24.1%)
Hispanic	5 (4.6%)	4-5 days	27 (25.0%)
Others	5 (4.6%)	≥ 6 days	50 (46.3%)
		Missing	1 (0.9%)
Household income/year:		Cooked dinner last week:	
Below $25,000	35 (32.4%)	None	11 (10.2%)
$25,000-$50,000	19 (17.6%)	1-3 days	30 (27.8%)
$50,000-$75,000	16 (14.8%)	4-5 days	45 (41.7%)
$75,000-$100,000	14 (13.0%)	≥ 6 days	21 (19.4%)
Above $100,000	21 (19.4%)	Missing	1 (0.9%)
Missing	3 (2.8%)		

Characteristics	*n* (%)	Characteristics	*n* (%)
Living with others:		Ate at restaurants last week:	
Yes	85 (78.7%)	None	9 (8.3%)
No	22 (20.4%)	1-3 days	74 (68.6%)
Missing	1 (0.9%)	4-5 days	18 (16.7%)
		≥ 6 days	6 (5.5%)
		Missing	1 (0.9%)
Tried weight loss last month:		Exercise last week:	
Yes	28 (25.9%)	None	33 (30.6%)
No	79 (73.1%)	1-3 days	38 (35.1%)
Missing	1 (0.9%)	4-5 days	21 (19.5%)
		≥ 6 days	15 (13.9%)
		Missing	1 (0.9%)
Weight loss methods: ($n = 28$)			
Diet	7 (25.0%)*		
Exercise	5 (17.9%)*		
Diet and Exercise	16 (57.1%)*		

*percentages are calculated based on 28 subjects

Table 2. Augmented Correlation Matrix (*N* = 108): Self-Efficacy, Self-Regulation, and Nutrition and Exercise Behavior Variables.

	Nutrition self-efficacy	Nutrition self-regulation	Fruit/vegetable consumption	Dinner cooking	Restaurant eating	Physical activity self-efficacy	Physical activity self-regulation	Exercise
Nutrition self-efficacy	1.000							
Nutrition self-regulation	0.649*	1.000						
Fruit/vegetable consumption	0.423*	0.527*	1.000					
Dinner cooking	0.282**	0.273**	0.483	1.000				
Restaurant eating	-0.033	-0.145*	-0.146	-0.489	1.000			
Physical activity self-efficacy						1.000		
Physical activity self-regulation						0.661*	1.000	
Exercise						0.632*	0.645*	1.000
SD	3.912	0.867	1.228	1.101	0.948	4.268	0.951	1.328
Mean	13.167	2.792	2.806	2.167	1.509	12.907	2.928	1.574

SD: standard deviation *indicates $p < .001$ **indicates $p < 0.05$